



# Combined VSWIR/TIR Products Overview: Issues & Examples

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# Introduction

## Context

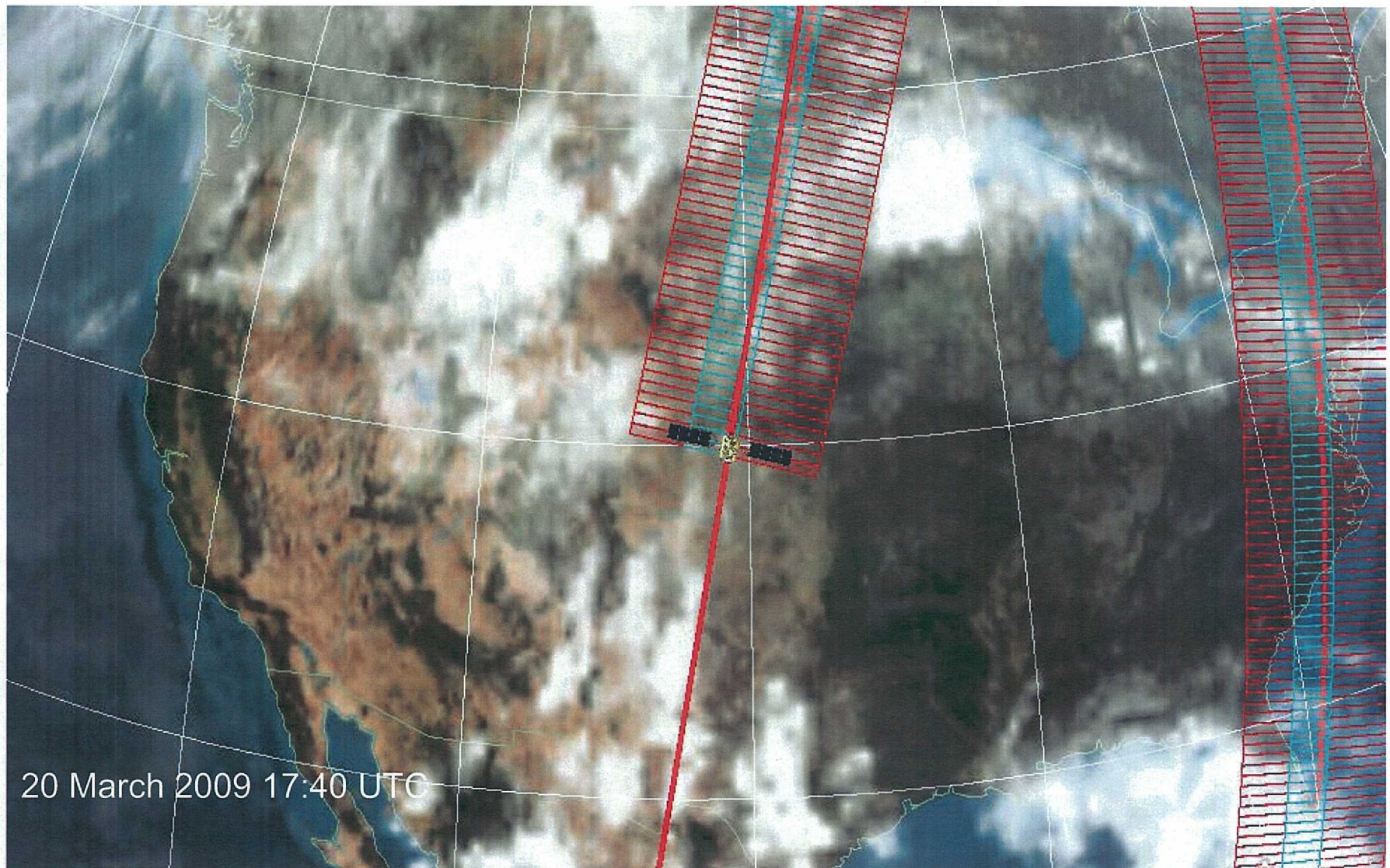
- VSWIR data collected at 19-day intervals for most areas.
- TIR data collected day & night on a 5-day cycle (more frequent at higher latitudes).
- TIR swath is 4X as wide as VSWIR ( $\therefore$  wider range of view angles).
- 5-day orbit repeat is approximate ( $\therefore$  same locations viewed from different angles and different GSD).

## Outline

- Nested swath geometry for reference point design.
- Coverage simulations for example FLUXNET tower sites
  - Re-visit frequency varies with latitude
  - Overpass times vary with latitude
  - Between VSWIR collects, TIR overlap geometry and timing varies with latitude (broadly) and location.



## HyspIRI observatory crossing 40 N in the central U.S.



VSWIR swath (light blue) is nested within TIR swath (red), with a swath center offset west of the satellite's ground track. (Cross-track rectangles drawn for simulated 5 s time-steps.) 20 March 2009, 17:40:10 UTC

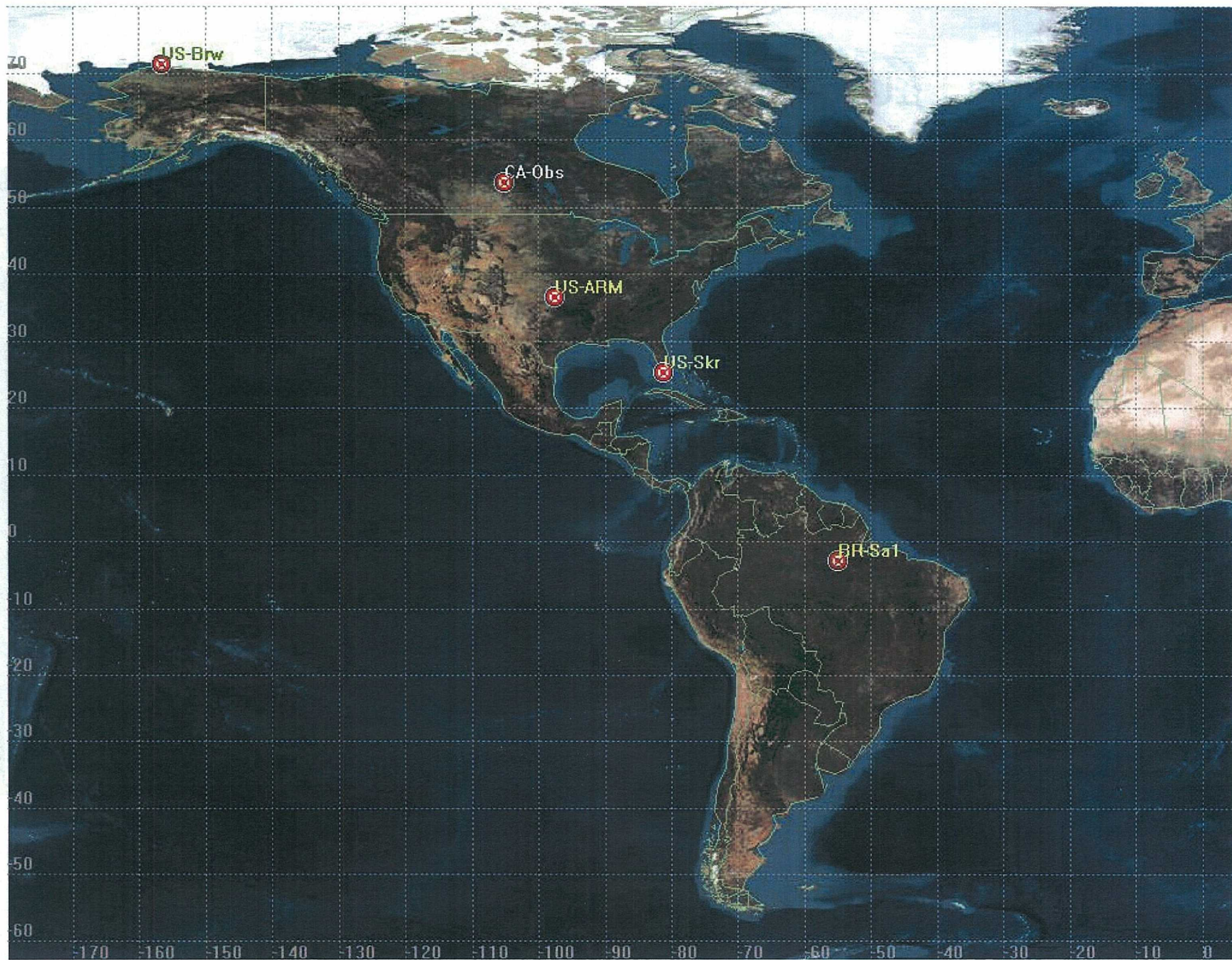


HyspIRI ground tracks shortly after completing a 5-day near repeat pattern:  
(a) blue – descending (day) passes and orbit track;  
(b) red – ascending (night) passes and orbit track.



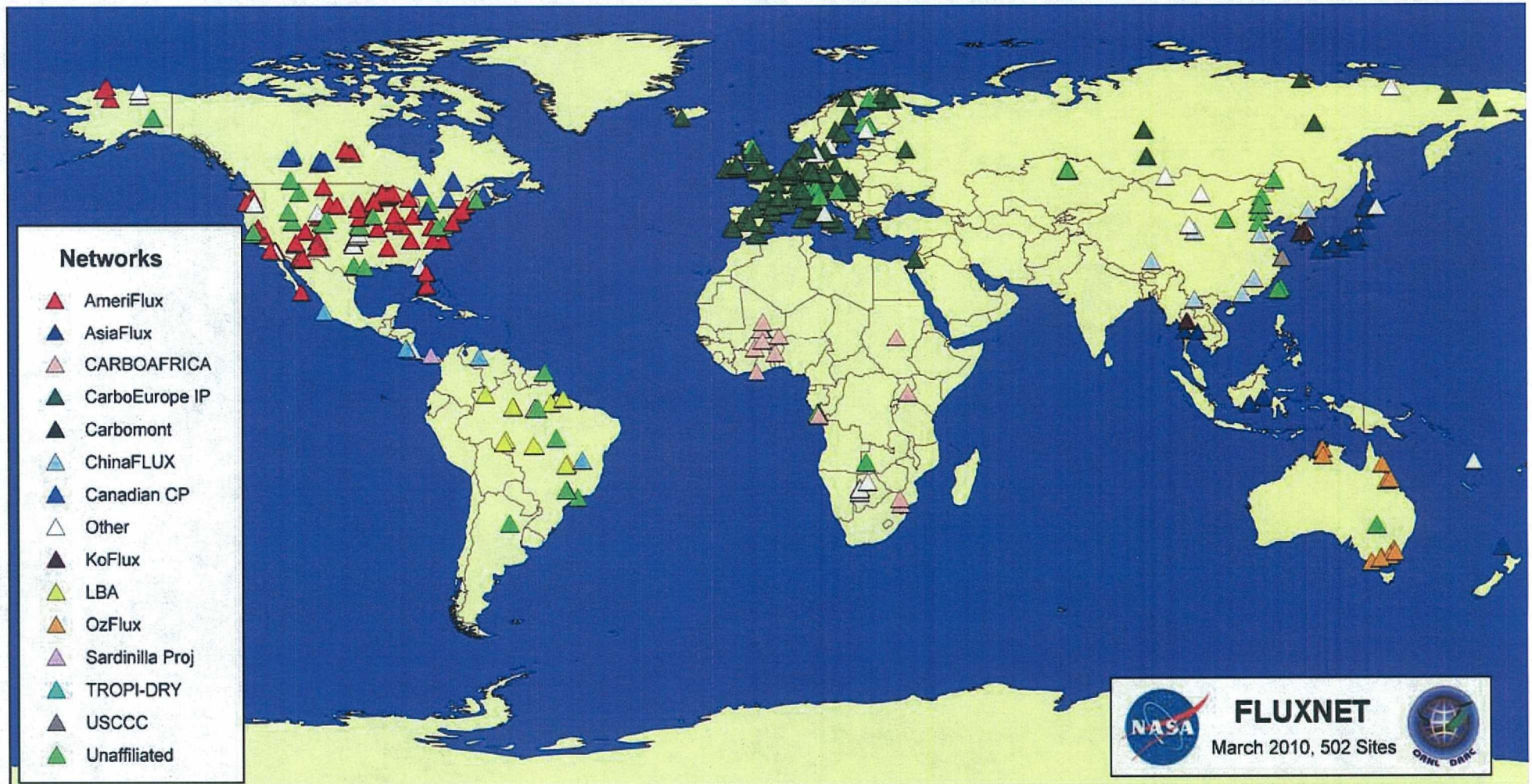
R.G. Knox simulation with STK v8.1.3. Orbit: alt. 626.8 km, inclination: 97.8°. Earth graphics courtesy of Analytical Graphics Inc.







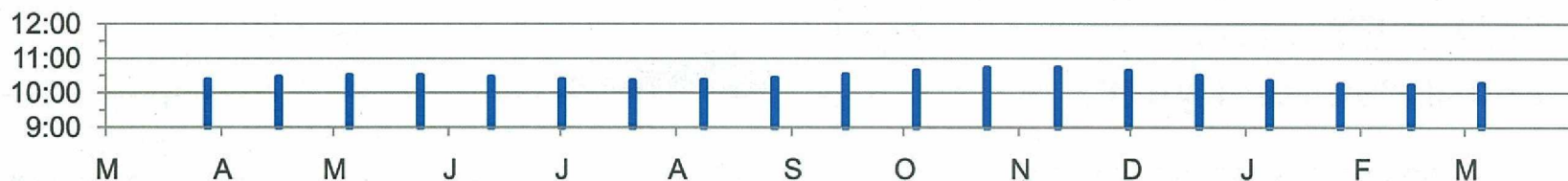
# What is FLUXNET?



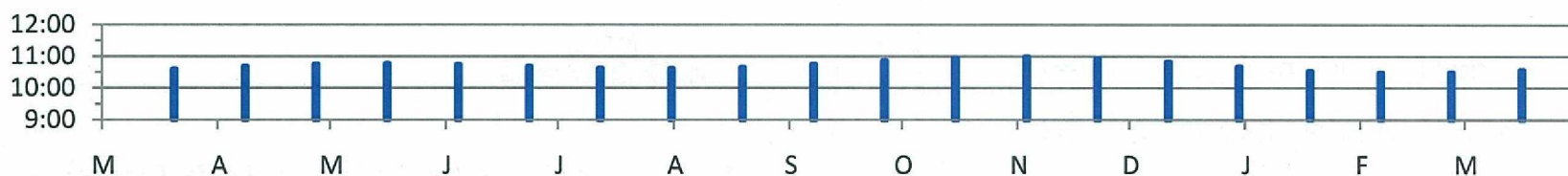


# VSWIR accesses for 1 simulated year

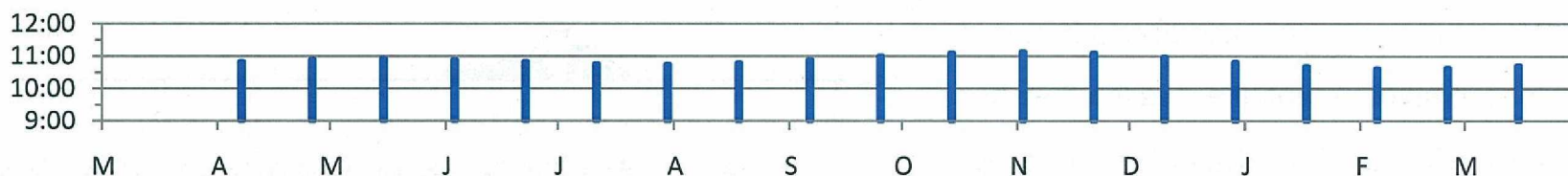
**Brazil - Santarem km 67 (LBA), Primary Forest (2.86 S)**



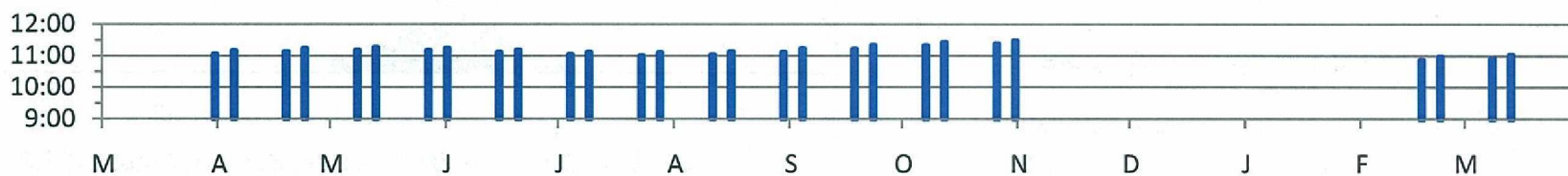
**US - Florida Everglades, Shark River Slough, Mangrove Forest (25.36 N)**



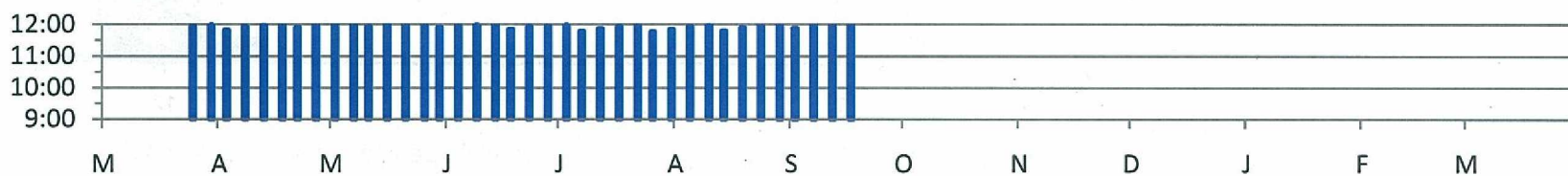
**US - ARM Southern Great Plains, Main Tower, Croplands (36.6 N)**



**Canada - Saskatchewan - (BOREAS) SSA Old Black Spruce (53.99 N)**



**US - Barrow, Alaska, Moist Tundra (71.32 N)**



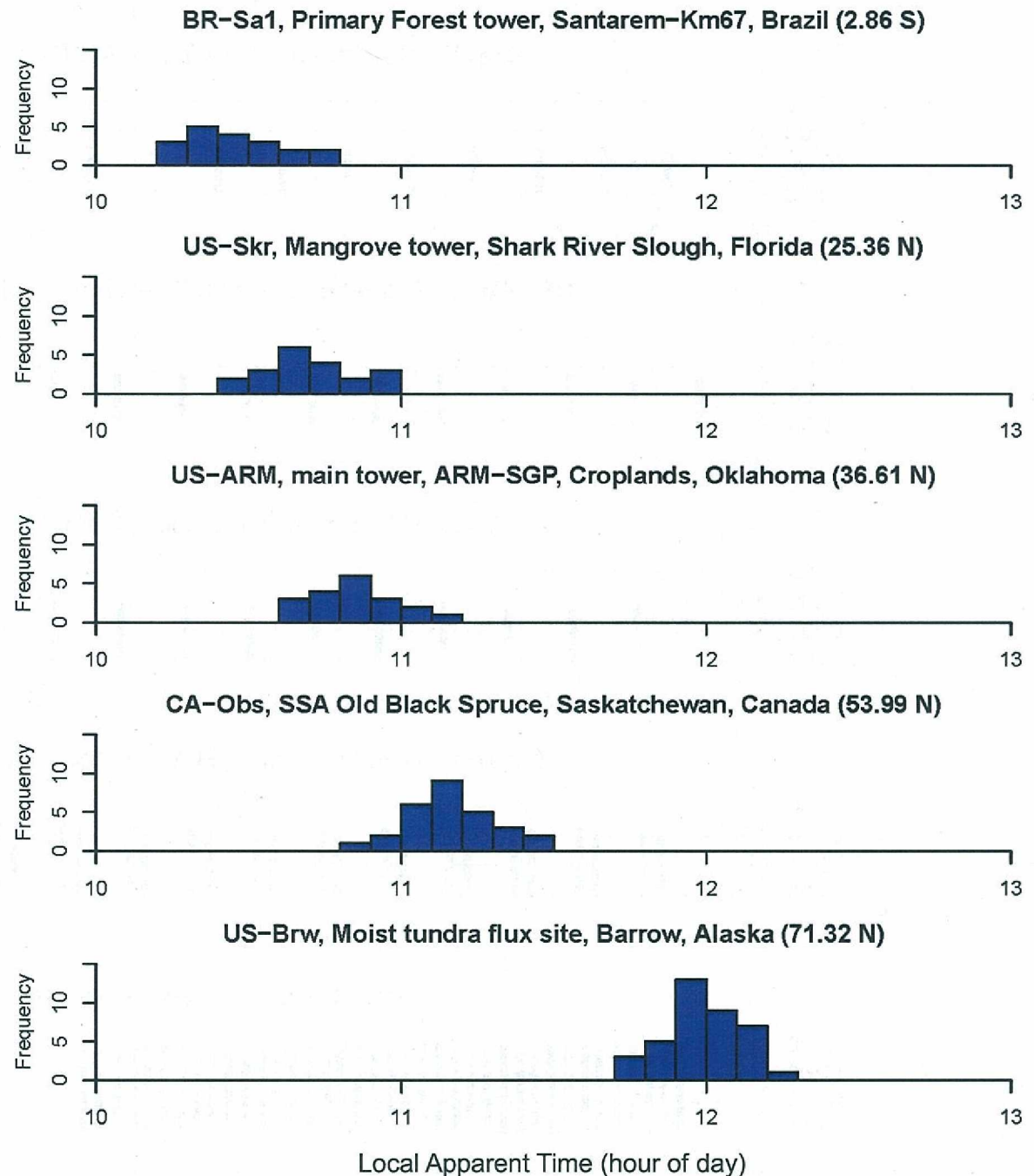
## Local time of VSWIR overpasses of 5 FLUXNET sites, simulated for 1 year

Local apparent time, for a fixed mean local time, varies with the Earth's orbit.

As the N latitude of the site increases, the local apparent time of potential VSWIR accesses also increase.

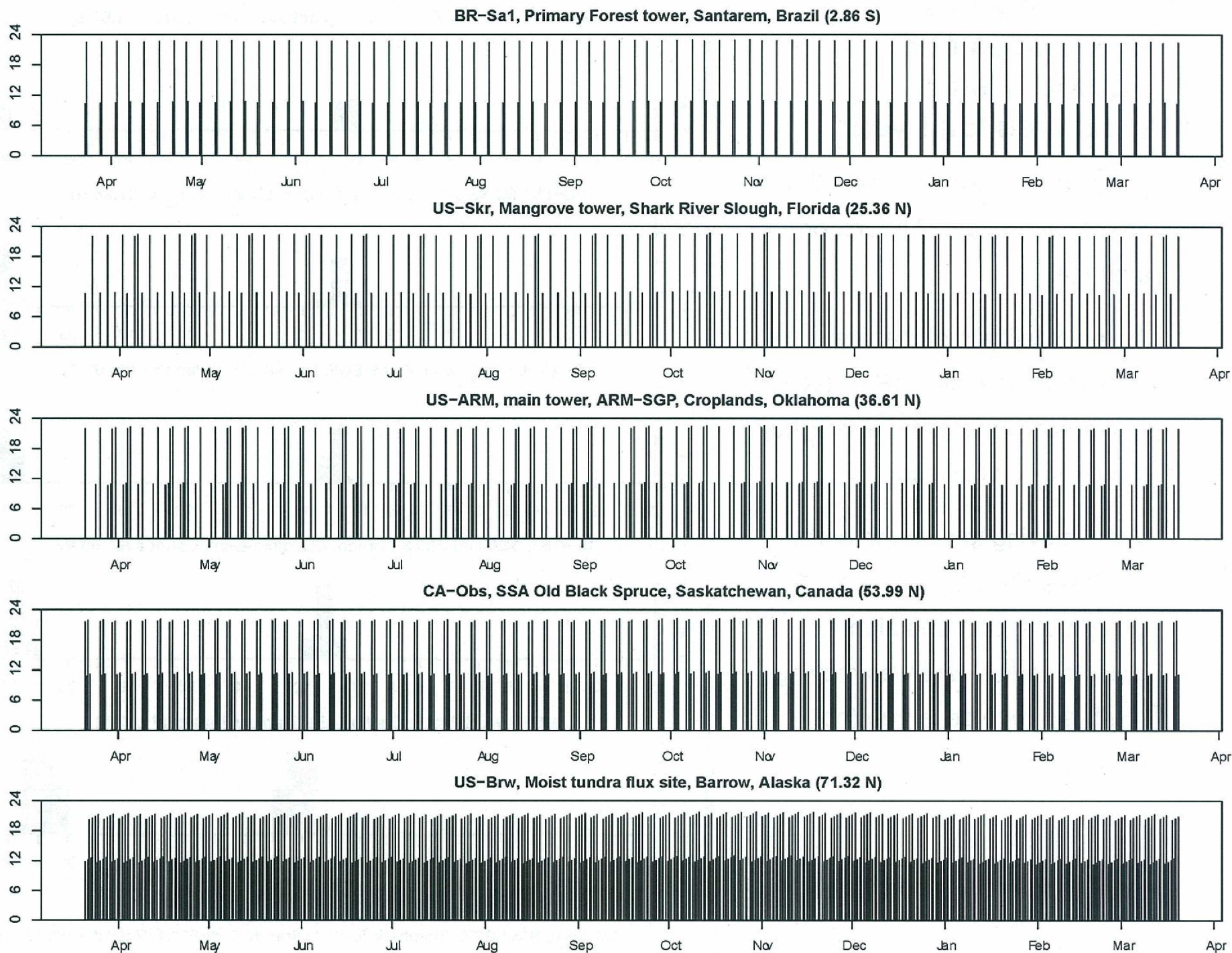
Near the north orbit pole (82.1 N) the local time of potential accesses may be nearly 6 hours later than when crossing the equator (not shown).

Moving toward the south orbit pole local times are progressively earlier in the morning (not shown).





# TIR accesses for 1 simulated year



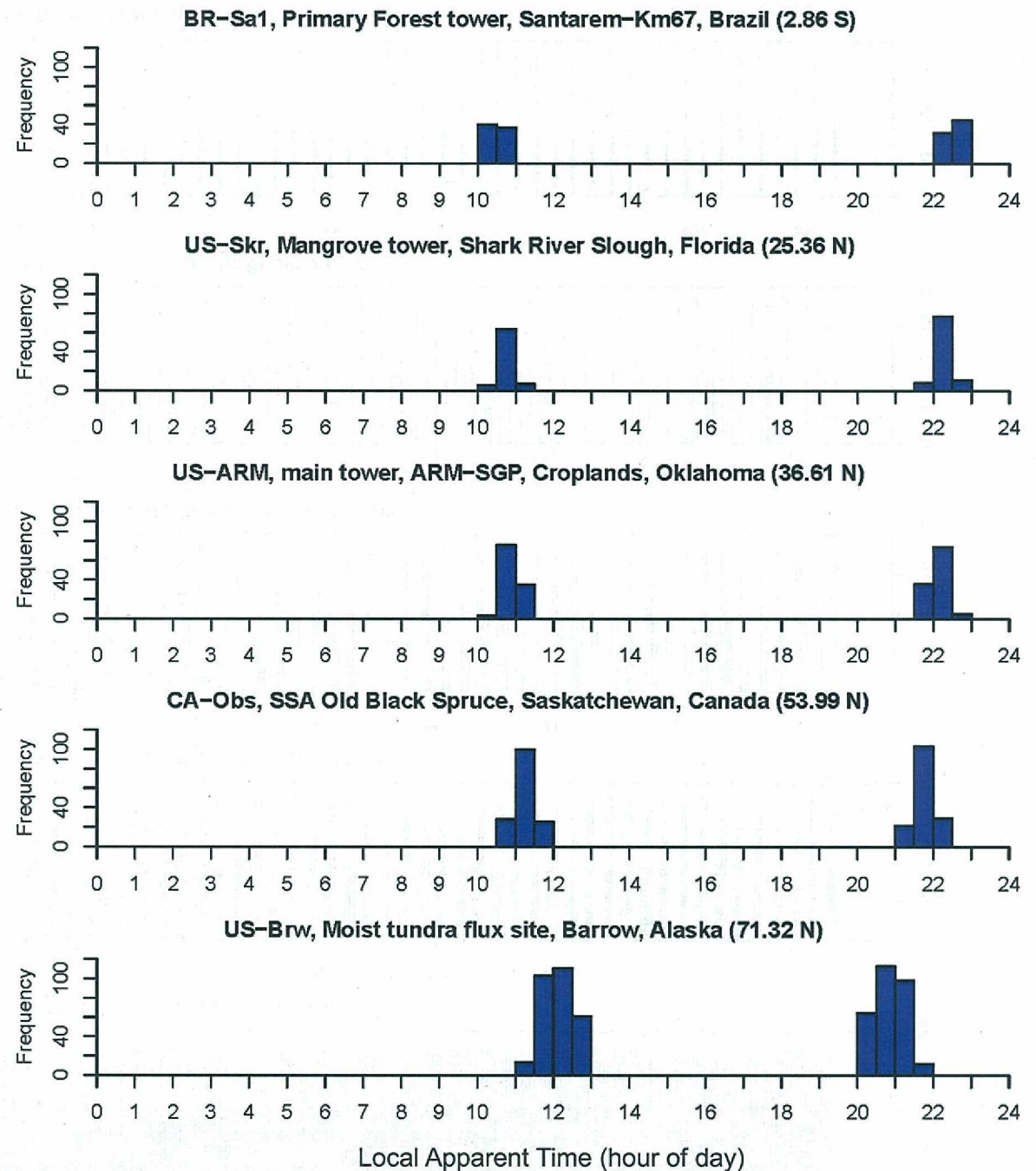


## Local time of TIR overpasses of 5 FLUXNET sites, simulated for 1 year

Near the equator, overpass times are separated by 12 hours, on average.

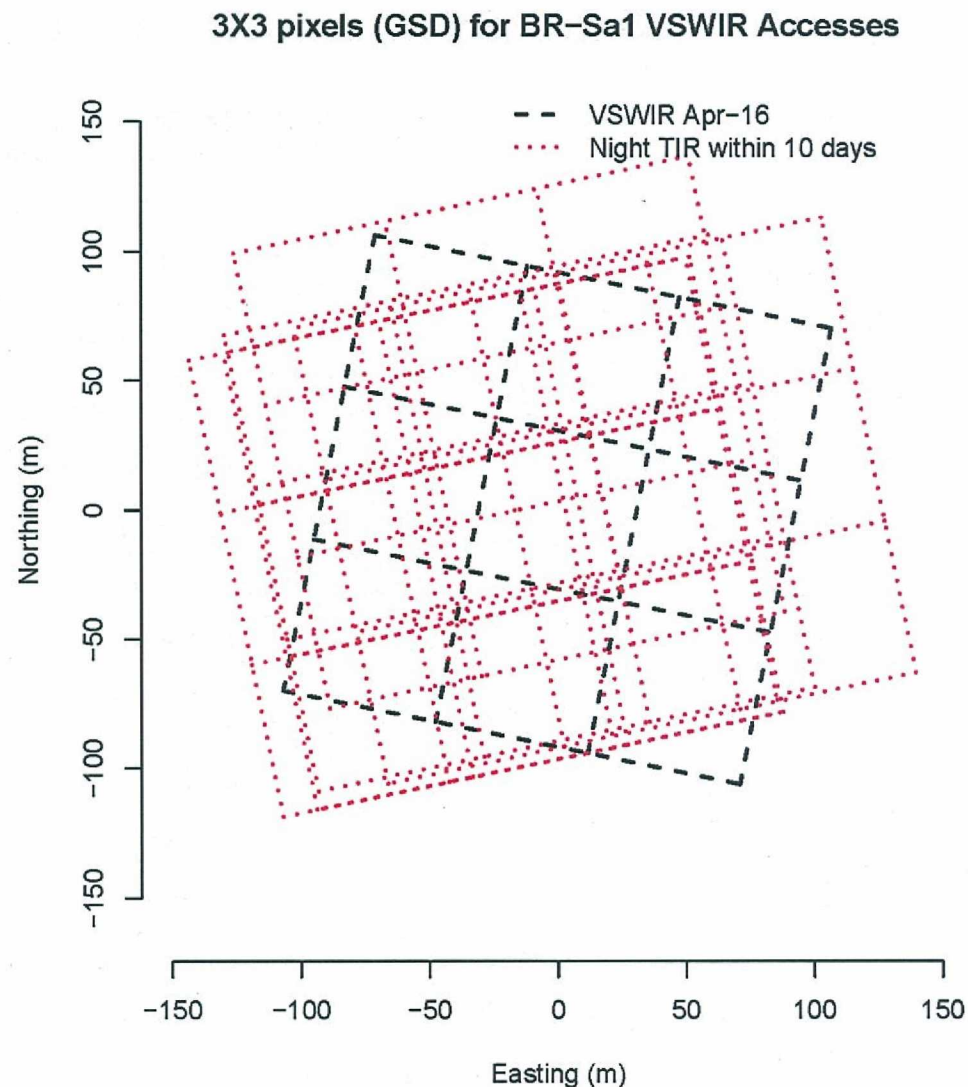
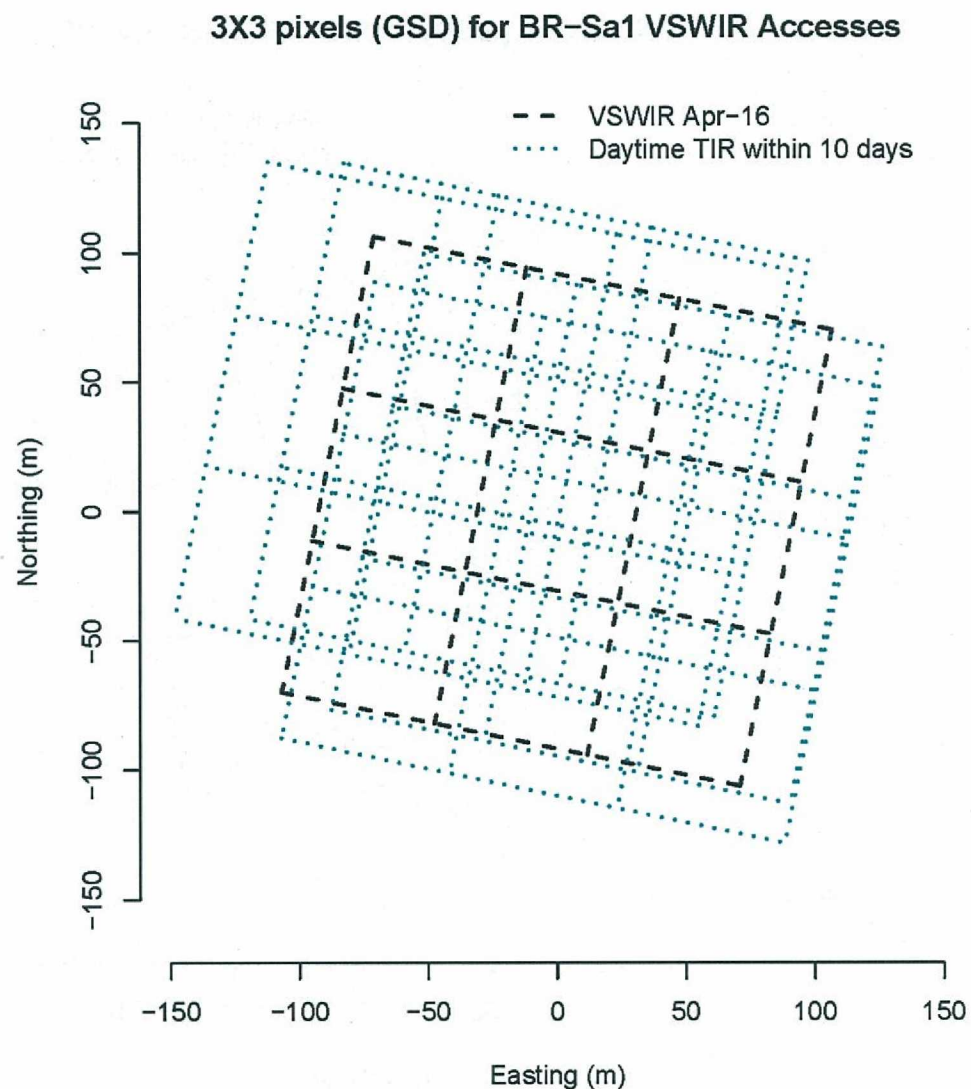
As the N latitude of the site increases, potential TIR collects are more frequent and less tightly clustered in local time.

Also, moving toward the north orbit pole (82.1 N) daytime collects are later and night collects earlier, whereas moving south the reverse is true (not shown).





## Example of potential HypsIRI TIR data within 10 days of VSWIR coverage, for a near-equatorial study site in Brazil

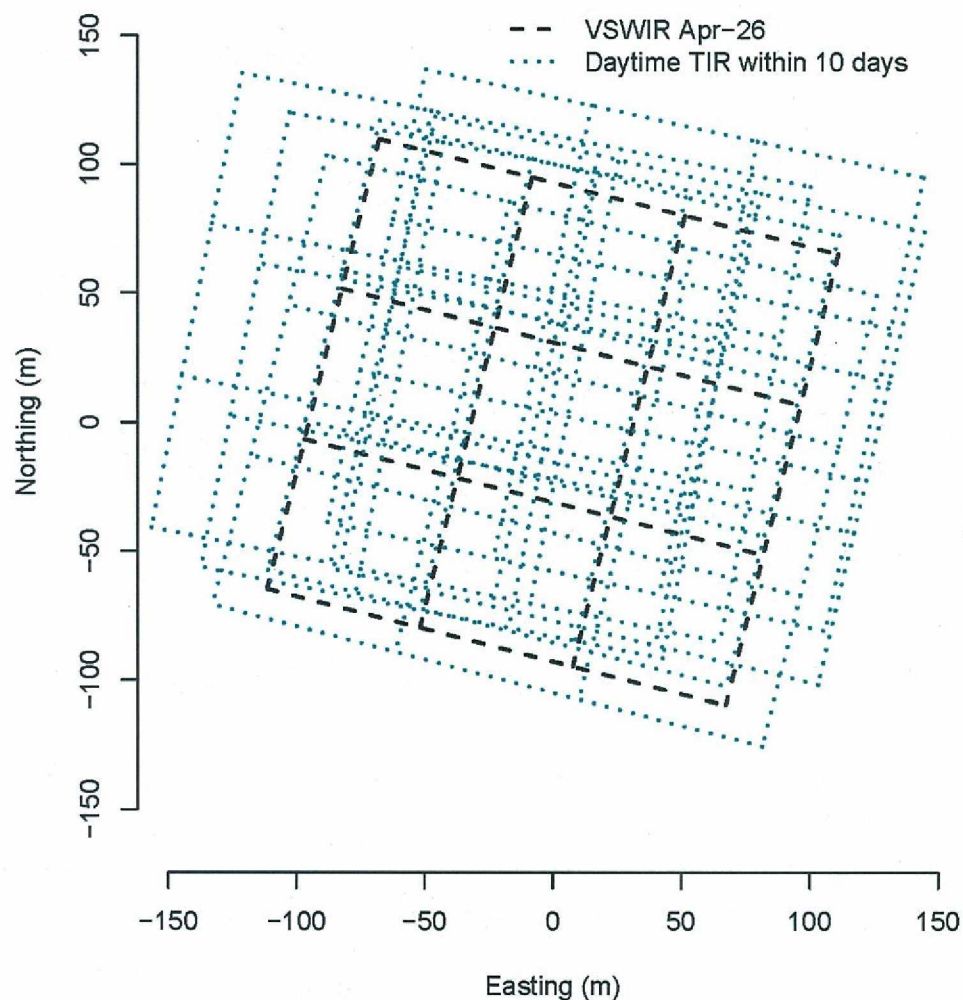


Daylight accesses (cyan) include 1 coincident with the SWIR coverage and 3 other dates.  
Potential night data (red) include 5 overpasses, 1 within 13 hours of the SWIR coverage.

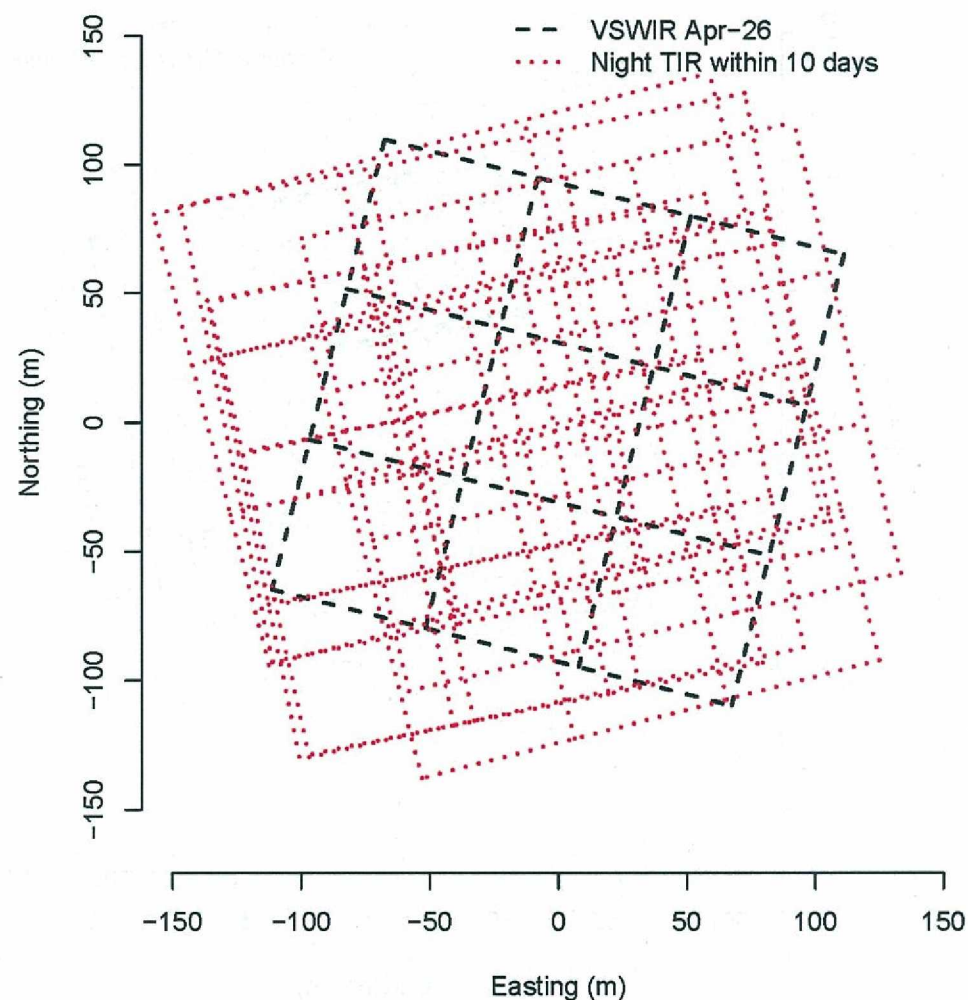


## Example of potential HypIRI TIR data within 10 days of VSWIR coverage, for a mid-latitude study site in Oklahoma

3X3 pixels (GSD) for US-ARM VSWIR+TIR



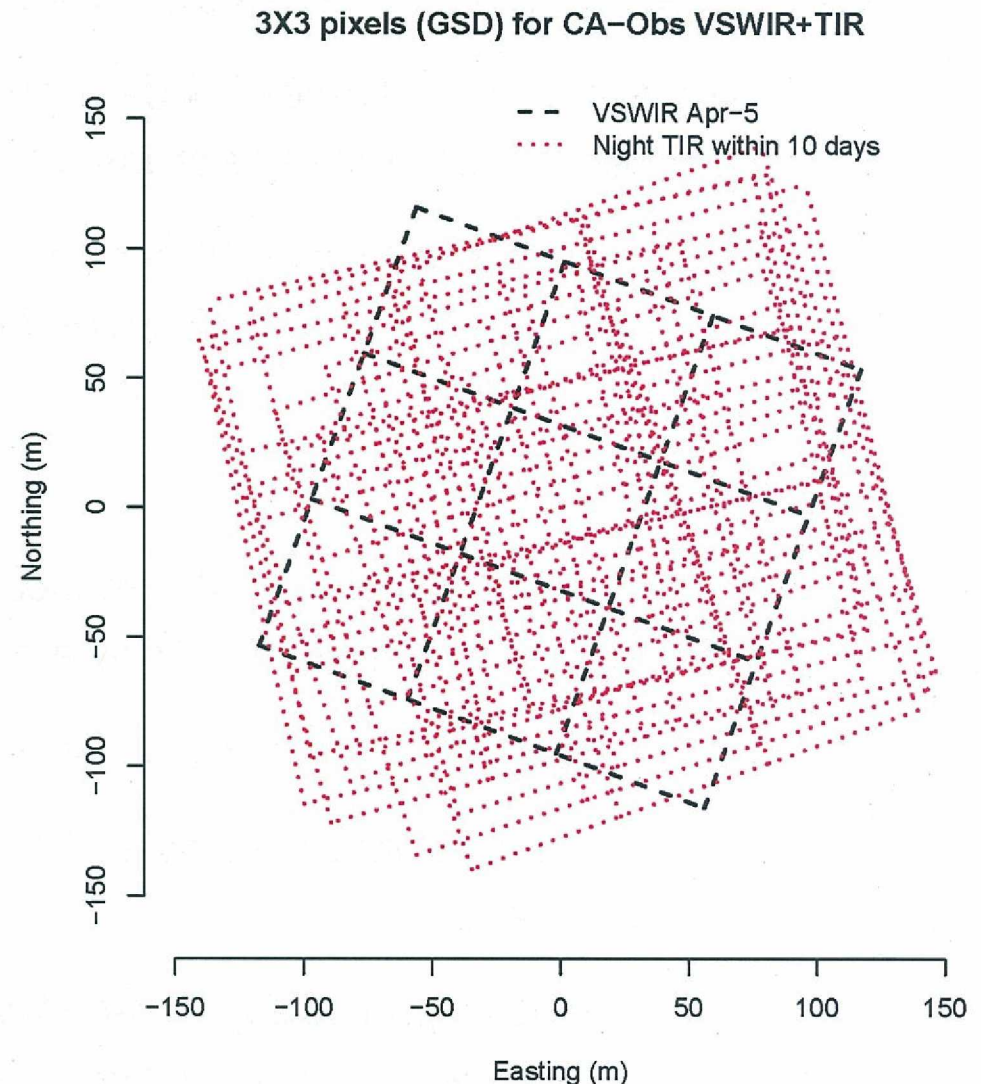
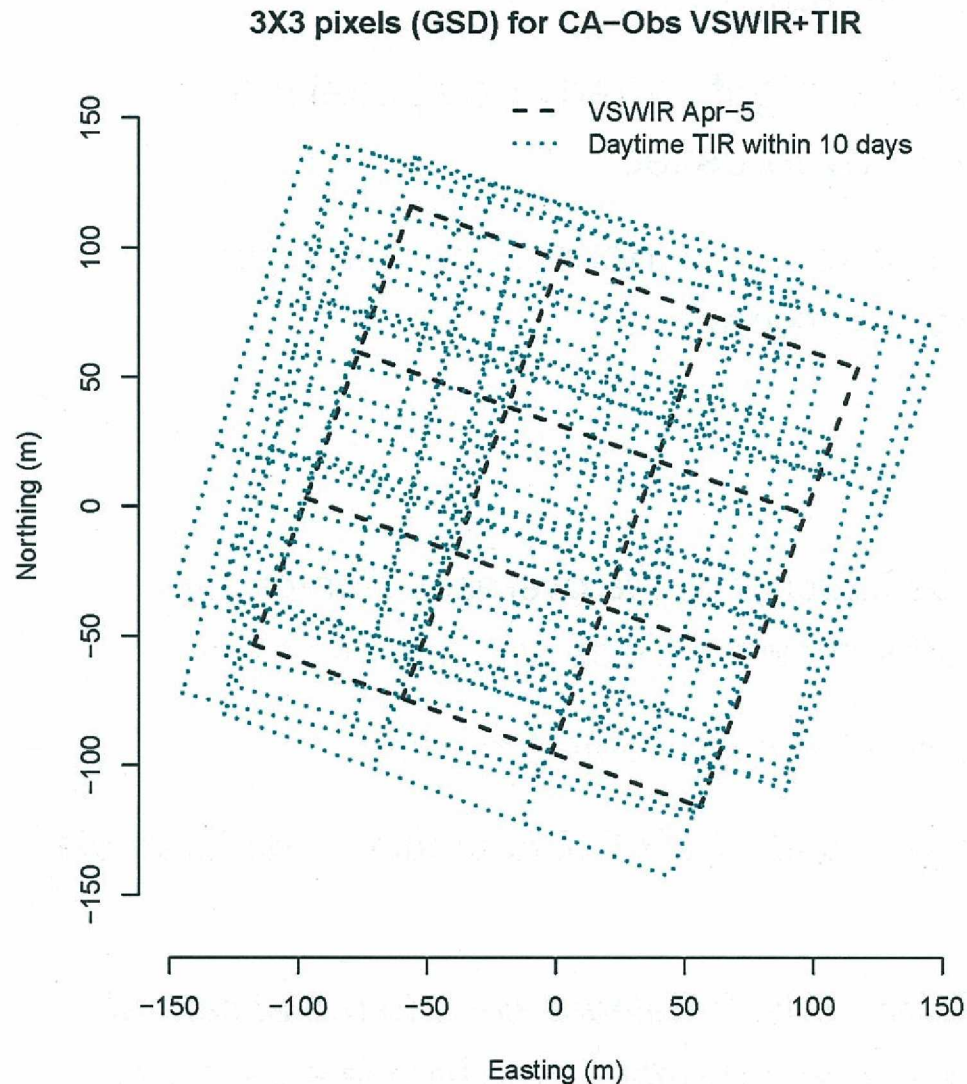
3X3 pixels (GSD) for US-ARM VSWIR+TIR



Daylight accesses (cyan) include 1 coincident with the SWIR coverage and 5 other dates.  
Potential night data (red) include 6 overpasses.



## Example of potential HypsIRI TIR data within 10 days of VSWIR coverage, for a boreal study site in Saskatchewan



Daylight accesses (cyan) include 1 coincident with the SWIR coverage and 7 other dates.  
Potential night data (red) include 9 overpasses.



# Some issues & options: Combined VSWIR & TIR data

- Level 2 pixels are geolocated but not re-sampled.
- Single-instrument level 3/4 data products might already be spatially re-sampled or composited across multiple overpasses.
- Providers of **global** combined data products may need to handle data volumes equivalent to both level 2 data streams.
- Questions:
  - *How might combined data products be affected by the overpass time-of-day differences or variation in view azimuths shown in these simulations?*
  - *Will HypsIRI need standard grids for multi-temporal data products?*
  - *What options for producing and distributing level 2/3/4 data products will be viable in 5+ years?*

*Regional processing & re-distribution nodes? Release code to run at central, regional, or end-user sites? Peer-to-peer distribution of high interest data?*